

that about 60 % of the boulangerite is massive, while the remainder forms unoriented fibres, up to 1 mm long, which are occasionally irregularly twinned. The massive boulangerite contains small inclusions of a light grey isotropic mineral, which may be sphalerite. The sulphides occur in a quartz vein within a grey tuffaceous slate of Middle Devonian age.

Dines (1956) has recorded workings for the antimony ores stibnite and jamesonite in this district, but the only recorded occurrence of boulangerite in Cornwall is an undescribed specimen from near Endellion, which Kingsbury and Hartley (1956) used as an X-ray diffraction standard.

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Diopside, lithium metasilicate, and the 1968 temperature scale

THE 1968 International Practical Temperature Scale (IPTS) defines a temperature scale at several points including the atmospheric pressure melting points of gold (1064.43 °C) and palladium (1554 °C). The 1948 IPTS assigned values of 1063.0 °C for gold and 1552 °C for palladium. The Geophysical Laboratory of the Carnegie Institute, Washington, uses a scale defined by gold, 1062.6 °C; diopside, 1391.5 °C; and palladium, 1549.5 °C (Sosman, 1952). On this latter scale Kracek (1930) fixed the melting point of lithium metasilicate at 1201 °C, which has been used by some workers as a secondary calibration point.

Before 1968, some workers used 'mixed' scales, e.g. taking gold as 1063.0 °C but taking diopside as 1391.5 °C. This results in only minor errors. More significant

differences would result from mixing the 1968 IPTS and the Geophysical Laboratory Scale. Before noting these, some experiments suggesting that lithium metasilicate has a higher melting point are reported.

For diopside (J. F. Schairer, pers. comm.) and for lithium metasilicate it is generally accepted that the disappearance of the last primary crystal is the calibration point. These materials were probably chosen in the belief that they melted congruently. It now seems probable that both melt incongruently and a diagram for diopside has been suggested (Biggar and O'Hara, 1969a). Within the incongruent melting interval there is a very rapid increase in the amount of liquid present in a range of no more than 2 °C below the disappearance of the last crystals. For many practical purposes this is a small enough range to be called a point and used as a secondary calibration point.

Three samples of lithium metasilicate were available. Analyses (by M. J. Saunders) showed 300 ppm Na₂O in sample A, prepared from lithium carbonate and from silica derived from tetraethyl-orthosilicate; 1300 ppm Na₂O in sample B, prepared by F. P. Glasser from lithium carbonate and pure crushed quartz; and 5000 ppm in sample C, during the preparation of which an alkaline solution was kept in glassware with presumed contamination by Na₂O and also B₂O₃ and SiO₂. In the course of calibrating the quenching furnaces described by Biggar and O'Hara (1969b), samples A and C are placed in neighbouring capsules. In many cases sample C melts while sample A remains solid and there appears to be a difference of about 2 to 3 °C in the temperature of disappearance of the last primary crystals. Samples A and B are nearly identical but there is detectably more liquid in sample B.

The melting point of lithium metasilicate (sample A) was determined. A quench furnace with a 12-capsule assembly was calibrated at the gold point with gold wires in three capsules, which were: the central capsule; an intermediate capsule; and a capsule near the outside of the assembly. Using, temporarily, the Geophysical Laboratory Scale the gold was observed to have been solid at 1067.6 °C and liquid at 1068.7 °C. The centre of this range, 1068.1 °C, was taken as the melting point. The calibration correction for this particular furnace and thermocouple was 1068.1 minus 1062.6, which is 5.5 °C. The same furnace was calibrated with diopside in the three capsules. The centre and outside capsules contained a sample of diopside prepared by the author. The intermediate capsule, between and touching each of the first two, contained a sample of diopside supplied by J. F. Schairer. At 1396.0 °C the three samples were solid with traces of liquid. At 1397.7 °C the diopside samples were liquid except for the sample at the centre, which contained very rare primary crystals and from this evidence it was accepted that there was a small temperature gradient through the assembly such that perhaps the central capsule is about 0.3 °C cooler than the outside capsules. The middle of the temperature range was 1396.9 °C and the calibration correction for this furnace was 1396.9 minus 1391.5 which is 5.4 °C. Lithium metasilicate, in similarly situated capsules, was observed to have melted at 1211.5 °C and to retain primary crystals at 1210.0 °C. The middle of the range is 1210.7 °C and subtraction of a calibration correction of 5.5 °C leaves a value of 1205.2 °C. This is a redetermined melting temperature of lithium metasilicate on the Geophysical Laboratory Scale.

A table shows: the Geophysical Laboratory Scale with this new value inserted; the 1948 IPTS with interpolated values for lithium metasilicate and diopside; and the 1968 IPTS with similar interpolations.

Temperature scales	Ag	Au	L ₂ S	Di	Pd	Pt
Geophys. Lab.	960.2	1062.6	1205†	1391.5	1549.5	1755
1948 IPTS	960.8	1063.0	—	—	1552	1769
by interpolation			1206	1393.3		
1968 IPTS	961.93	1064.43	—	—	1554	1772
by interpolation			1208	1395.3		

†redetermined as described

One consequence of these changes is to reduce interlaboratory discrepancies, which were as great as 8 °C. In the system CaO–MgO–Al₂O₃–SiO₂ two of the equilibria involving diopside and spinel were reported to melt at 1230 °C ± 0.5 and at 1233.5 °C ± 1.5 (O'Hara and Biggar, 1969) but two values each of 1238 °C ± 3 were reported by Schairer and Yoder (1970). The reassigned values on the 1968 scale would be 1236.5 °C ± 0.5 and 1240 °C ± 1.5 for the work of the former authors and two values at 1241 °C ± 3 for the latter workers.

Correction is also required to some previous comments by the author on calibration and particularly to an irregular curve of calibration correction versus temperature (Biggar and O'Hara, 1969b, fig. 7). The new melting point of lithium metasilicate results in a calibration correction 4 °C higher in fig. 7. The silver point in the original fig. 7 is totally in error. In the presence of oxygen, silver forms a low-melting-point eutectic and no precaution to exclude atmospheric oxygen was taken in obtaining data for fig. 7. The extent of the error is about 10 °C (C. E. Ford, pers. comm.) and the result is to lower the silver calibration correction in fig. 7 by this amount. The point was wrongly plotted at 980 °C in fig. 7. It should be at 961 °C. With these changes it now appears that a curve that is almost a straight line would fit the modified data points of fig. 7.

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